

MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Total Maximum Daily Load Information Sheet

Center Creek

Water Body ID: 3203

Water Body Segment at a Glance:

County: Jasper
Nearby City: Joplin
Length: 26.8 miles
Pollutants: Cadmium (in sediment and water)
Lead (in sediment)
Source: Tri-State Mining District



State map showing location of watershed

Schedule for TMDL development:

TMDL development schedules are subject to change.

The most current schedule for TMDL development is available on the department's website at dnr.mo.gov/env/wpp/tmdl/wpc-tmdl-progress.htm

Other TMDLs:

The U.S. Environmental Protection Agency approved a TMDL for zinc in 2006.

At the time of this writing, a TMDL to address bacteria (*E. coli*) in Center Creek is being developed as part of a larger TMDL plan for the Spring River watershed.

Description of the Problem

A water body is considered impaired when it fails to meet applicable water quality standards. Water quality standards consist of designated uses, water quality criteria, an antidegradation policy and implementation procedures. Center Creek is impaired due to exceedances of state water quality criteria that protect aquatic life designated uses.

Designated uses of Center Creek*

- Warm Water Habitat (WWH)
- Cool Water Habitat (CLH)
- Whole Body Contact Recreation Category A (WBC-A)
- Secondary Contact Recreation (SCR)
- Human Health Protection (HHP)
- Irrigation (IRR)
- Livestock and Wildlife Protection (LWP)
- Industrial Water Supply (IND)

*In addition to these specific uses, all waters of the state are protected by the general water quality criteria that are specified in the state's Water Quality Standards at 10 CSR 20-7.031(4).

Designated uses that are impaired

- Warm Water Habitat (WWH)
- General Criteria

Criteria that apply

- Missouri Water Quality Standards for toxic substances at 10 CSR 20-7.031(5)(B)1 state:

Water contaminants shall not cause the criteria in Tables A and B to be exceeded.

Concentrations of these substances in bottom sediments or waters shall not harm benthic organisms and shall not accumulate through the food chain in harmful concentrations, nor shall state and federal maximum fish tissue levels for fish consumption be exceeded.

- Table A of the Water Quality Standards contains dissolved metals criteria for the protection of aquatic life designated use (WWH). These criteria are hardness dependent and limits are calculated from the formulas shown below:

Dissolved Cadmium

$$\text{Acute}^1 = e^{(1.0166 \cdot \ln(\text{hardness}) - 3.062490)} \cdot (1.136672 - (\ln(\text{hardness}) \cdot 0.041838)) = \mu\text{g/L}$$

$$\text{Chronic} = e^{(0.7409 \cdot \ln(\text{hardness}) - 4.719948)} \cdot (1.101672 - (\ln(\text{hardness}) \cdot 0.041838)) = \mu\text{g/L}$$

- Missouri has no numeric criteria for metals in sediment. Likewise, federal guidelines have not yet been established for toxic chemicals in stream or lake sediments. In lieu of such criteria, Probable Effect Concentrations, or PECs, suggested by McDonald, et al.², are used to assess toxicity in stream sediments. PECs are the concentrations at which some toxic effect on aquatic life is likely.
- Missouri streams are also protected by the general criteria found at 10 CSR 20-7.031(4). The particular general criteria that apply to Center Creek include:
 - (D) Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal, or aquatic life.
 - (G) Waters shall be free from physical, chemical or hydrologic changes that would impair the natural biological community.

Background information and water quality data

Mine drainage, both in the form of surface flows and resurgence of groundwater from flooded mines, contributes significant amounts of metals to Center Creek. In addition to dissolved metals in the water column, studies by the U.S. Geological Survey, or USGS, also indicated that at some locations pore water, water within the sediment on the bottom of Center Creek, was toxic to aquatic life.

¹ Acute criteria apply to short exposures to toxic conditions that aquatic creatures can survive without harm. Chronic criteria apply to conditions producing adverse effects on aquatic life or wildlife following long-term exposure but having no readily observable effect over a short time period. Chronic criteria values are typically lower than acute criteria values.

² *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems*, D. MacDonald, et al., 2000. USGS

Dissolved cadmium

Cadmium is a minor component in most lead ores and therefore a by-product of lead production. It is known to be highly toxic and carcinogenic. The chronic and acute water quality standards for protection of aquatic life for cadmium are based on the 25th percentile hardness level of the water. A water body is judged to be impaired if chronic or acute numeric criteria are exceeded on more than one occasion during the last three years for which data is available. Available cadmium data from 2010 to 2012 show the chronic criterion was exceeded seven times in Center Creek during this time period (Figure 1).

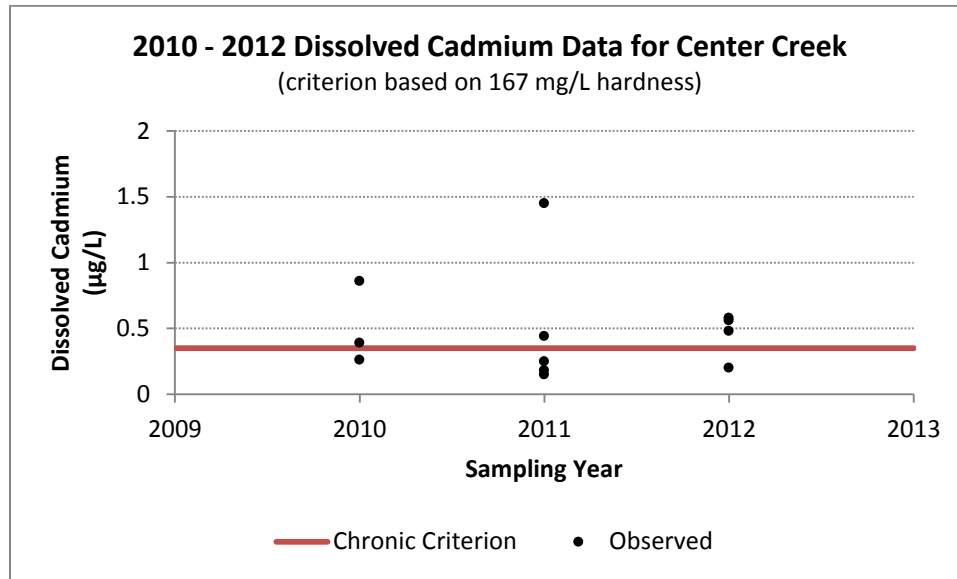


Figure 1

Cadmium and lead in sediment

The sediment in Center Creek eroded from formerly huge chat piles created by mining lead and zinc. Chat is the crushed limestone and other ore rock left over after the lead and zinc were extracted. The relationship between the amount of a toxicant in sediment and the strength of the toxicity it exerts on aquatic life is not simple or straightforward. While neither Missouri nor EPA has standards or guidelines for sediment toxicity, the USGS has reviewed a large number of research papers on the subject. Based on this review, the USGS suggests numeric guidelines that could be used to judge the potential for toxicity to aquatic life (Table 1). These are the PECs mentioned in the discussion of “criteria that apply.”

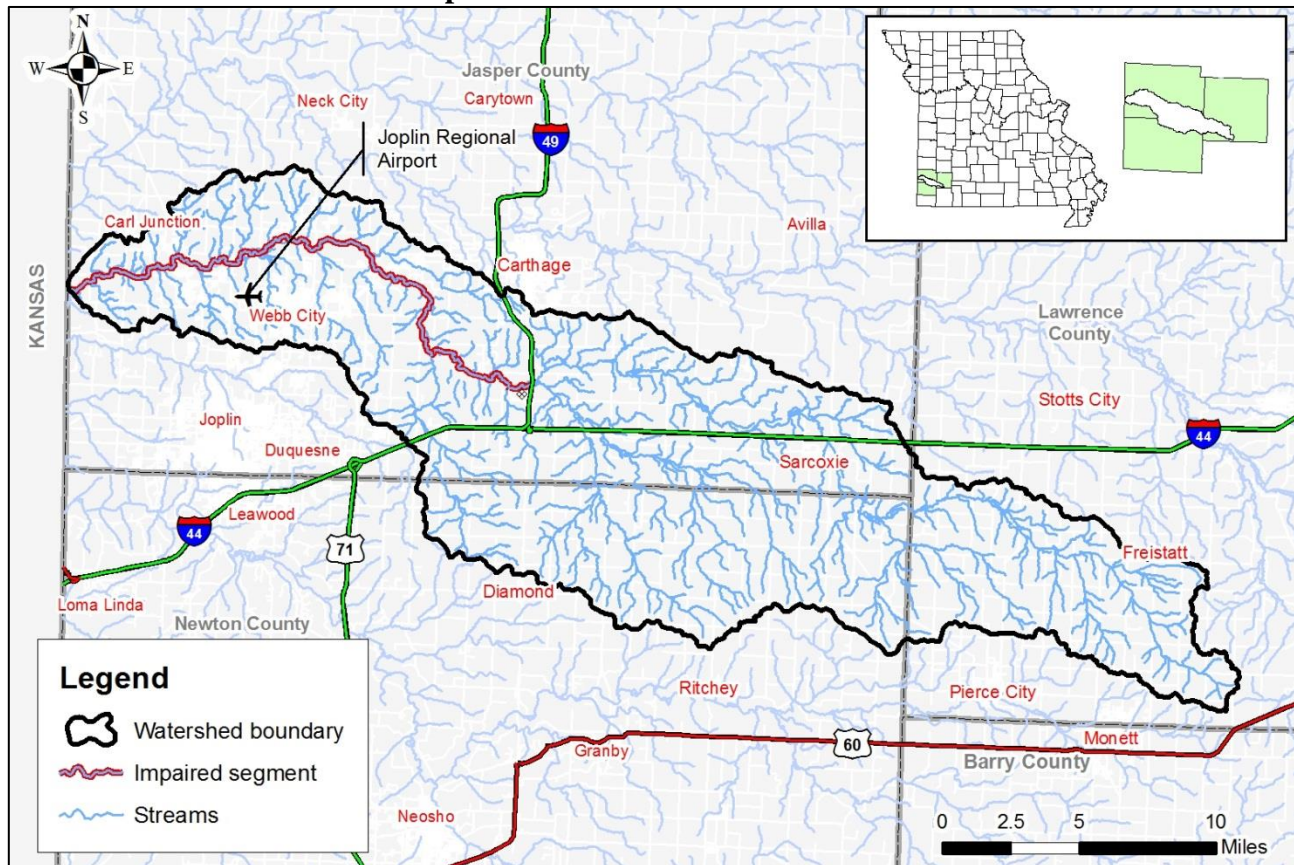
Table 1. Metals in Sediment Data for Center Creek (data from 1991 – 2007)

<i>Pollutant</i>	<i>PEC (mg/L)</i>	<i>Center Cr. Geometric Mean (mg/L)</i>
Lead	128	205
Cadmium	4.98	20.40

TMDL for Center Creek

The Center Creek TMDL will calculate the maximum amount of each listed pollutant that the stream can receive and still meet water quality standards. The TMDL will also identify all potential or suspected pollutant sources in the watershed and distribute the allowable pollutant loads among those various sources. When developed, the Center Creek TMDL will use the most current and available data. For this reason, the final TMDL may present information that differs from that contained in this information sheet.

Map of the Center Creek Watershed



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